

## Effect of the built environment on public health



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### ARTICLE INFO

#### Article history:

Received 10 June 2018

Received in revised form

1 October 2018

Accepted 5 October 2018

#### Keywords:

Ecology

Cycle

Built environment

Skyscrapers

Public health

### ABSTRACT

In this article, the relationship between the ecological cycle and life, the built environment and life, the effects of the built environment on the public health are examined with the literature research technique and information about the interaction between ecology, built environment, skyscrapers and public health in various publications is presented. İstanbul was selected as a sample working area. The aim is to emphasize the relationship between high structures and the human health of these structures. The weakness of the study is that it does not investigate its effects by making field measurements. The strong direction of the study is that the effects of high buildings increasing day by day today are based on the literature studies of the effects on human health.

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### 1. Introduction

Living beings maintain their life by making use of natural resources and in interaction with each other. In addition to breathing, humans' most basic needs can be categorized under three heading such as: The need for eating and drinking, accommodation and dressing. As a result of decrease in the need for man power and emigration from rural areas after industrial revolution and mechanization, the concept of urbanization emerged and disorderly planned cities are designed according to the need for accommodation, which is one of the basic needs of human kind, rather than being designed in a way that it doesn't harm the nature as a part of the nature and cities comprised of dense structural clusters. The density of structured environment completed its development with the population increase and overbuilt cities continue to grow vertically with the technological developments in construction systems. In this paper, the ecological cycles, which are needed for the lives of living beings, are discussed and the importance of natural environment is emphasized. The harmful effects of the human-caused destruction of the nature on the environment are classified and illnesses that might be caused by this environmental damage are examined.

In this article, the relationship between the ecological cycle and life, the built environment and

life, the effects of the built environment on the public health are examined with the literature research technique and information about the interaction between ecology, built environment, skyscrapers and public health in various publications is presented. In this context; first, ecologic life will be addressed and then a brief history of İstanbul's planning will be given and an emphasis will be laid on the effects of structured environment and high structures on public health.

### 2. Ecological life

Living beings maintain their lives in interaction with each other. In order to understand this interaction, one needs to examine the cycle of life. Cycle is a repetition of several events. This cycle is based on mutual benefit. Cycle theory states that all living beings can benefit from each other and the life of living beings goes on in this way. According to 14040.2 ISO in 2006 life cycle is a consecutive and interconnected stage of product service system, starting with natural resource extraction until the stage of final disposal. Life cycle includes: biotic cycles, energy cycle (nutrient cycle), photosynthesis, respiration, abiotic cycles, oxygen, carbon, nitrogen, sulphur, phosphor, cycles, sedimentary cycles, and hydrological cycles.

Each cycle of life is required for living beings to maintain their lives. Where does Ecology stand in this life cycle? [Lancour \(2015\)](#) defined the ecology in 4 groups:

- Population - a group of individuals of the same kind that populate a common geographical area,

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<https://doi.org/10.21833/ijaas.2018.12.009>

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- Community - two or more population of different kinds that populate the same geography areas - only biotic factors of populations and communities,
- Ecosystem - a community and abiotic factors, e.g. Soil, rain, temperature etc.
- Biosphere - The part of the world that includes the living beings.

Population, society and biosphere interact with each other and continue their lives on earth. Respiration and water are basic needs of living beings. In order to meet their respiratory needs, living beings provide benefit to the ecology (Figs. 1 to 3)

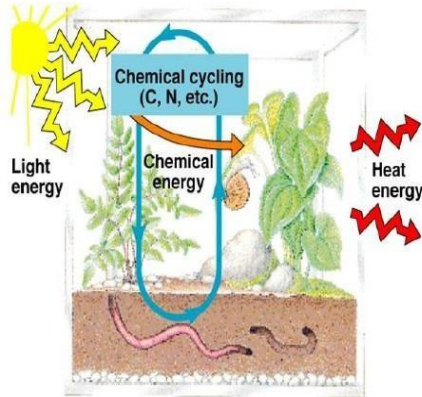


Fig. 1: Ecosystem and biosphere cycle (Lancour, 2015)

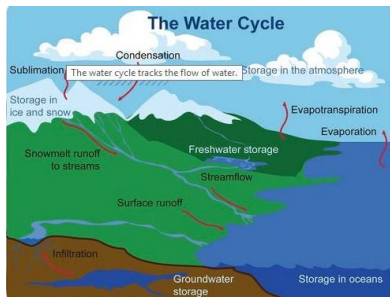


Fig. 2: Water cycle (Lancour, 2015)

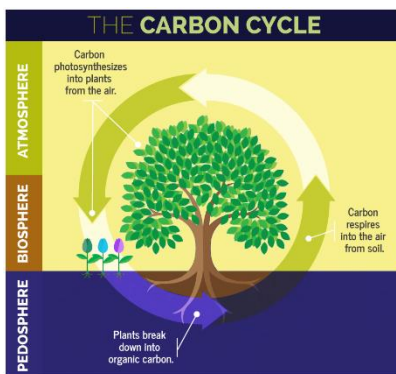


Fig. 3: Carbon cycle (Lancour, 2015)

Despite of the fact that ecological life is important for human beings, building structures are built by ignoring the environmental issues. As a result of environment pollution, some illnesses may occur and consequently environment pollution caused by humans harms the humans. The continuity of life on earth can only be possible with the regular

continuity of substance cycles such as water, oxygen, carbon dioxide, nitrogen, sulphur, magnesium, which are known as the continuous balance of the environment and eternal restorers. In an ecosystem, which is the living space, the pollution of substance that is required for life such as air, water, soil or disturbance in water, carbon dioxide, nitrogen cycles makes life and life conditions difficult (Akin, 2014). In order to evaluate Istanbul's urbanization process and structured environment establishment, which is the subject of this paper, the history of planning decisions must be discussed.

### 3. Planning history of Istanbul

On the second half of 19<sup>th</sup> century, the transformation of Istanbul's social structure was spatial transformation. A new era began in 1923 with the declaration of the Republic. After being the capital for years, Istanbul lost this title to Ankara. After Istanbul as an old capital and losing this administrative power, a socio-economic transformation process began in Istanbul (Sengezer, 2009). Between the years 1923-1928 is known as unplanned development period in Turkey. In this period the plans of Istanbul were developed by Carl Lörcher. The years among 1930-1950 are an important period in terms of Istanbul's development. Since it was a post-war period, significant changes took place for Istanbul. When we take a look at planning activities in Istanbul, we see a considerable amount of destruction. This can be prominently seen in four periods:

1. Cemil topuzlu period (1912-1914)
2. Lütfi kırdar period (1938-1949)
3. Fahrettin kerim gökay Period (1949-1957)
4. Bedrettin dalan period (1984-1989)

The main reason of physical environment's rapid transformation can be explained with urbanization. Within the literature, urbanization is examined in two parts as before the industrial revolution and after the industrial revolution. The industrialization and the mechanization of agriculture provided the ability of feeding more people with the same amount of soil and this led to population increase. Decrease in the need for man power due to mechanization has led to immigration to the cities and therefore this cause urbanization.

Upon the foundation of modern Turkey and acceleration of economic and social development, a very strong, rapid and partially irregular commercial and industrial development was observed within the Turkish society. While old cities acquire a new appearance in parallel with this development in trade and industry, several new cities are added in addition to these old cities as well. In parallel with the economic recovery that is foreign-dependent and therefore demonstrating irregular, unequal and unstable characteristics; a disorderly and irregular urbanization was observed. Istanbul is the most significant example that demonstrates the certain

characteristics of this disorderly and irregular urbanization.

#### 4. Structured environment's effect on public health

In this paper, structured environment refers to infrastructure and superstructure built by humans. Public means being related to all humans in a country or society. Within the scope of these definitions, in this paper the term public health will be used as being related to the health of humans living in a country or city. While at first living powerless against and dependent to the nature, the human kind have come to a position to dominate the nature with the culture and technology they developed in time. However the relationship between the human and the environment is a relationship that puts human to the center ignores the environment and damages the ecological balance (Özerkmen, 2002). This situation directly affects the life cycle and becomes unsolvable. The structured environment created by humans affect the ecological cycle and therefore negatively affects the human kind with its effects that deteriorate human health.

The need for accommodation is one of the basic needs of the human kind. The urbanization with the industrial revolution and the cities established with no consideration of the ecological balance as a result of the rapid urbanization caused cities to transform into dense structural clutters. The structured environment that supposed to be considered and designed with natural environment in mind began to be formed on the basis of structure-structure relationship as a result of the destruction of the natural environment. This situation was described in one of the eight principles expressed by Arne Naess, 'The intervention of the humankind on non-human life forms is extreme and because of this extreme intervention the situation goes worse' Interventions carried out by the human kind becomes harmful for the human kind and living beings as a result of the ecocide. Densely structured cities based on structure-structure relationship causes environmental pollution and this situation negatively affects human health. As a consequence of the harm done on the nature some environmental pollution occurs. Environmental pollutions are problems that occur as a result of disorderly and dense urbanization in cities. Environmental pollutions are categorized under the following headings:

- 1- Air pollution,
- 2- Water pollution,
- 3- Soil pollution,
- 4- Noise pollution,
- 5- Visual pollution

These environmental problems for humans are; health problems caused by air pollution: Increased air pollution negatively affects the health of living beings and especially on humans, it causes several

acute health problems. Long-term exposure to polluters causes chronic health conditions to occur. Air pollution causes coughing, bronchitis, heart disease and lung cancer. Air pollution, that causes negative effects even on healthy people, can affect vulnerable groups more easily and might cause more severe problems such as:

1. Health problems caused by water pollution: Polluted drinking water is one of the most common environmental dangers in many countries around the world. Children, who live in unhealthy conditions or drink polluted water, are exposed to more frequent and serious problems; the majority of them pass away before the age of five due to the diseases such as diarrhea, cholera and malaria related with water and sanitation (Pandey, 2006). Güler (1994) listed the health problems caused by water pollution as follows. The water containing a substance unsuitable for health might carry and contain several diseases. The water might contain dissolved or undissolved inorganic salts, bacteria and parasites. These cause illnesses such as poliomyelitis, contagious hepatitis, enteritis, FMD, swine fever etc.
2. Health problems caused by soil pollution: Unlike their behaviors in air and water, the pollutants in the soil do not generally spread quickly. They mainly create different pockets (hot points). Soils are comprised of the phases of solid, liquid and vapor. During such phases, the pollutant division determines how to behave and what environmental and public health risks to pose (Kibble and Russell, 2010). As a result of soil pollution, illnesses such as liver, kidney and nutrition disorders occur (Güler, 1997).
3. Health problems caused by noise pollution: Pursuant to Jariwala et al. (2017), noise pollution causes hearing disorder, negative social behavior and disorder, communication problem, sleeping disorders, cardiovascular disorders and mental health disorders. Noise pollution negatively affects the auditory perception of people, their physiological and psychological balance and decreases working efficiency.

Ranging from air, water, soil, noise and visual pollution of the living place to the communicative disorders between people, all kinds of negative environmental conditions negatively affects the people's biological, psychological, cognitive and social structures.

#### 5. Vertical growth and public health in cities

'Multi-layered structures' is another aspect of the problem of using urban lands to the benefit of the society. Especially on the vertical and land parts of the city center, in order for people to take advantage of several dense storied structures, the planning is focused on skyscrapers (Geray, 1991). Tall buildings that have a negative impact on the city's silhouette

bring along many problems in city planning; it has a negative effect in terms of problems such as unsolved infrastructure systems, shadow and sun forms, occurrence of dark streets and traffic circulation.

Vertical urbanization causes city silhouette, air, water, soil pollution as well as illnesses ranging from respiratory disorders to cancer. A skyscraper that prevents air flow directly contributes to air pollution. Since population density is focused on vertically growing areas the need for water increases in the area and the increased amount of water causes water and soil pollution. Also the dense population in these areas increases traffic and also contributes to air and noise pollution.

### 5.1. History of skyscrapers

The history of tall buildings dates back to the second half of 19th century. One of the first revolutionary inventions that increased building height and number of stories was passenger elevator invented by Alisha Graves Otis in 1857 and the other one was the usage of iron and then steel skeleton structure. Thus, reduced the burden on buildings and provided space saving (Çoban, 2016).

While architectural forms that are used by each governments to establish a hegemonic relationship that would provide a positive effect on their existence occurred as temples, theatres and the Pantheon in the Ancient Greece; public buildings, arenas and forums in Rome; cathedrals in the Middle Age; palaces and barracks in the Baroque period, It wouldn't be wrong to state that skyscrapers have been used to the same end at late 20th and early 21st centuries (Çoban, 2016). Skyscrapers rise all around the world and prominently on Asian and American continents. 76% of 81 skyscrapers completed in 2014 are on United States of America. Cities that have the most skyscrapers are New York and Hong Kong. At the world scale, there are more than 85350 skyscrapers (Moore, 2006).

Whereas the word skyscraper is known as the name of the horse that won the Epsom Derby in 1789, it is also a type of hat and a term referring to high flying balls in cricket and basketball. The words usage for tall buildings is based on a metaphor related to seamanship: Skyscraper means the tallest sail of a ship. Similar to the first sign of a ship approaching to the land, tall buildings are the first sign of a land when approaching from sea. The term 'skyscraper' began to be used in architecture in a later period than the emergence of skyscrapers.

### 5.2. Skyscrapers and public health

Skyscrapers, at the end of their lives of structure, significantly increase the carbon emissions, which is observed in their construction, operation, maintenance and demolition. The density that they create on infrastructure and transportation system causes traffic problem. Tall buildings deteriorate the characteristics of neighborhood and cityscape as

well as causing negative impacts on the climate. The turbulence created by their wind negative affects the users. They also diminish the access to have natural light and natural ventilation (Al-Kodmany, 2018).

Al-Kodmany (2018) listed the negative impacts of tall buildings as follows:

- 1- Energy and carbon emission,
- 2- Urban heat island impact,
- 3- Wind,
- 4- Increase in sea level,
- 5- Geological changes,
- 6- Bird Collisions,
- 7- Waste management

According to Al-Kodmany (2018):

- 1- The construction and operation of skyscrapers require major energy and create significant level of carbon emission and air pollution that contributes on the global warming.
- 2- High rises consume a lot of steel and concrete – too much energy is needed to produce such materials, which cause major carbon dioxide emissions.
- 3- They might cause temperature increase within the city by 10-12 Fahrenheit.
- 4- Urbanization weakens natural ventilation since the buildings block the breeze from the natural areas such as ocean, sea, lakes, forests, farms and mountains.
- 5- Tall buildings on coastal lines increase the water level.
- 6- They deteriorate the geological structure with their weight.
- 7- They cause birds collision.
- 8- Since tall buildings have big population, they generate substantial amount of waste. Averagely, the proportion of waste by an apartment unit is about one ton per year.

While the total construction area of skyscrapers in Istanbul is 8,660,000 m<sup>2</sup>, percentage of buildings concentrated on Sisli, Besiktas, Sariyer districts (Besiktas-Maslak and Mecidiyekoy axis) is 75% (Şengezer et al., 2009). Today, structures are almost in a competition of height. And this brings about some problems. Like Infrastructure problems, architectural and technical problems, heating and insulation vulnerabilities, carrying construction materials to higher storeys, bending and distortion on the building's steel construction due to natural factors such as wind and earthquake and security problems (Çoban, 2016).

Tall structures also bring about problems that affect city life. Glass construction used in tall structures and the height of buildings increases the city's temperature and causes the wind directions to shift. Also in skyscrapers, where there is a high level of energy consumption, the amount of water consumed is quite high as well.

The density in skyscrapers, populated by thousands of people, increases vehicle traffic and



therefore the gases emitted from the vehicles' exhaust increase air pollution.

Dr. Nilüfer Aykaç Kongar, Co-Chair of Air Pollution Period Group at Thorax Association which is one of the constituents of Clean Air Platform formed by organizations such as Turkish Medical Association (TTB), Turkish Thorax Association (TTD), Doctors for the Environment Association, Greenpeace, Public Health Experts Association (HASUDER), Said that air pollution is an important public health issue, indicating that there is an increase in the number of people treated in pulmonology departments recently and she also explained that although reports don't include 'air pollution' as a cause of death, air pollution has severe effects on lung, heart and nerve system and pointed out that people suffer health problems such as asthma, chronic bronchitis, respiratory tract infection, heart attack and coronary failure. Showing the OECD data as an example, Kongar stated that 7 million people in the world died because of air pollution and according these reports the number of people died because of air pollution in Turkey within the last year is 29,000 people. This figure is 6 times more than the ones died in traffic accidents.

## 6. Conclusion

The need for accommodation as one of the basic needs of mankind, rise of urbanization with the Industrial Revolution and cities shaped by ignoring the ecological balance in the context of cities as a result of rapid urbanization have become into dense building blocks. The built environment, which should be considered and designed with the natural environment, has become to be shaped on the basis of building-building relationship as a result of the destruction in natural environments. The interventions of people and ecological destruction have gained a detrimental nature on the mankind and living creatures. Through the rapid urbanization, the cities with increasing building density have environmental pollution that negatively affects the

human health. The built environment, which is planned without considering the natural environment, damages nature and cause environmental problems, which can be classified as air, water, soil, noise and visual pollution. A number of health problems arise such as respiratory diseases through air, infections through water, metabolic diseases through soil, hearing disorders through noise. Environmental problems are man-made and consequently humans are affected.

## References

- Akın G (2014). İnsan sağlığı ve çevre etkileşimi. Ankara Üniversitesi Dil ve Tarih-Coğrafya Fakültesi Dergisi, 54(1): 105-116.
- Al-Kodmany K (2018). The sustainability of tall building developments: A conceptual framework. Buildings, 8(1): 7-38.
- Çoban F (2016). Kentsel Mekanın Dikey Örgütlenişi: Gökdelenler. Phoenix, Istanbul, Turkey.
- Geray C (1991). "Çok Katlı Yapı" lar ve Kentsel Toprak Siyasamız. Ankara Üniversitesi SBF Dergisi, 46(1): 225-242.
- Güler ZÇ (1994). Su kirliliği. Sağlık Bakanlığı, Ankara, Turkey.
- Güler ZÇ (1997). Toprak Kirliliği. Sağlık Bakanlığı, Ankara, Turkey.
- Jariwala H, Syed HS, Pandya MJ, and Yogesh MG (2017). Noise pollution and human health: A review. In the Noise and Air Pollution: Challenges and Opportunities Conference, 1-4.
- Kibble A and Russell D (2010). Contaminated land and health. In: Maynard RL et al. (Eds.), Environmental medicine: 565-573. CRC Press, Florida, USA.
- Lancour KL (2015). General principles of ecology. Green Generation. Available online at: <https://www.soinc.org/>
- Moore BT (2006). On the skyscraper as a building type in an era of uncertainty, globalization and environmentalism. PhD Dissertation, University of Florida, Gainesville, USA.
- Özerkmen N (2002). From anthropocentric perspective to eco-centric perspective. Ankara Üniversitesi Dil ve Tarih-Coğrafya Fakültesi Dergisi, 42(1-2): 167-185.
- Pandey S (2006). Water pollution and health. Kathmandu University Medical Journal, 4(1): 128-134.
- Şengezer B, Evren Y, Ökten AN, and Kozaman Som S (2009). Kentte yaratılanlar ve paylaşılanlar: İstanbul'da gökdelenler üzerine bir inceleme. Megaron Journal, 4(2): 71-78.